of this investigation, no matter how much it costs, even an appropriation of fifty times the amount carried by the bill, could be profitable expended, if one grass can be obtained of utility to man that will flourish as those worthless plants flourish in that dry arid region."

The division has now in preparation a popular work on the grasses and fodder plants of the country, designed chiefly as a ready reference book for the use of farmers, and also a more elaborate and fully illustrated hand-book of the grasses of North America. The former work will be completed within a year, while the latter, owing to the time required in preparing and executing the illustrations, can not be completed at so early a date. Much time is occupied in the office in identifying grasses sent in by collectors and correspondents, and parties are now in the field, working under the direction of the Chief of the Division, collecting grass seeds, live roots of grasses and forage plants and herbarium specimens, both in the Rocky mountain region and in the Gulf region of the Southern States. Special attention will be given the present season to the sand binders of the Atlantic coast, and to the grasses and other fodder plants which enter into the composition of the hay of the tide-water marshes along the Middle and New England States. This subject, while apparently of local importance, is one of considerable general interest and of much value, as any one who has visited our coasts can not fail to recognize. The agents in the West have been directed to collect in considerable quantity the seeds of all the more promising grasses of the rich grass flora of the Rocky mountain region, with a view of testing the several species under cultivation, particular attention being given to those kinds which appear to thrive and make vigorous growth under the most trying conditions of the arid climates.

The study of living plants and observing their habits of growth, whether in their native station or under cultivation, is absolutely essential to their proper investigation, and to meet this requirement the Secretary has established a grass garden upon the Department grounds, in which already some 400 different varieties of grasses and forage plants are now growing. Owing to the limited area of this garden, the plots assigned to each species are necessarily small, but they are sufficient to test the possibility of the growth of the several kinds in this latitude, and to show very well the peculiar nature of each species. It has been the endeavor to have in this garden illustrative living samples of all the various hay and fodder plants and all grasses advertised by different seedsmen, and to bring together in it all the native grasses which it may be possible to secure. A larger garden, of several acres in extent, has been established in one of the Southern States, where the native grasses peculiar to these States are being tested, and where a considerable area is given to the cultivation of the more promising fodder plants believed to be best adapted to our southern latitudes, both for the purpose of giving these plants a test of a more practical character, such as they would be likely to receive in general culture, and to secure seeds for distribution in cases where such a distribution seems to be desirable.

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PHOTOTOPOGRAPHY.

Photographs obtained on vertically exposed plates, using a camera with constant focal length and a lens ground especially with a view towards reducing astigmatic and chromatic aberrations to a minimum, giving uniformity in definition and depth over a flat field, may be regarded as geometrically true perspectives.

The true dimensions of objects, represented in perspective view upon a plane surface, are not obtainable by direct measurements with any one scale, but they can be determined, geographically, if the *distance line* (focal length), *the horizon* and the *principal point are known.*

Iconometry, photogrammetry or metrophotography are terms applied to that art which ascertains, graphically, the true dimensions of objects from their perspectively correct (photographic) representations (produced by means of a so-called photogrammeter).

By applying the inverse rules of perspective drawing and aided by a knowledge of descriptive geometry, the horizontal projections of the terrene, obtained by means of a photogrammeter, can be plotted in precisely the same manner as if the measurements were made in the field, instead of being obtained from such photographs.

The fundamental principles underlying this particular branch of photogrammetry—'phototopography'—are, of course, the same as in all other methods of topographical surveying, inasmuch as all require the determination of lengths of lines and angular measurements of the deflections of such lines from a given direction.

Generally speaking, phototopography follows the same lines of procedure as the plane table methods, except that with the latter the control underlying the map is plotted and the chart is drawn in the field, the terrene of the mapped area being before the eyes of the plane-tabler, whereas the iconometrical draughtsman has only the perspective views of the terrene, as seen from known stations, from which he must while in his office gather all the data necessary to construct the same map. Still, the latter has the advantage that he can, at any time, refer back to the terrene (pictorially at his command) surrounding any station, while the plane-tabler rarely occupies the same station twice, notwithstanding such references are very essential aids towards giving the topography a correct interpretation with respect to forms.

In both cases the chart is constructed by means of visual rays or lines of direction, drawn from different stations towards the same point, the cartographic position of which is found by locating the point of intersection of such lines, observed from different stations.

With the plane-table such intersections are made (or plotted) by bisecting the objects or signals with the (telescopic) alidade, and actually drawing the lines of direction observed from different stations to the same point, upon the plane-table sheet, thus plotting the horizontal angles (graphically) without knowing their values in arc.

In phototopography the lines of direction (in both the vertical and horizontal sense) to the various points, identified on different panorama views and selected for plotting, are found by transposing linear measurements taken (as rectangular coordinates) from the negatives or prints, which, together with the camera constants, will enable the iconometrical draughtsman to graphically locate the lines of direction and plot the points (selected on the pictures) by intersections of the same.

Such being the case, it is evident that the smallest length measurable with eye and scale will represent the limit within which the points of the map can be correctly laid down, and it becomes advisable to use a large scale for good photogrammetrical plotting.

The work of drawing in the horizontal contours, after a sufficient number of points have been located on the chart, hypsometrically and geographically, is done in the same manner (by graphical interpolation) as in the field, when using the plane-table, except that in iconometrical plotting frequent reference is taken to the pictures of

the area in question (as seen from different camera stations), they being studied in the same way as the plane-tabler studies the surrounding terrene to grasp its characteristic forms and represent the same on the map as a faithful translation.

Among the advantages of applying photography, in the manner suggested, to surveying are:

1. With the same material brought home from the field, large or small scale maps can be constructed, and the plotting can be made detailed or generalized by deducing a large or a small number of geodetic control points from the photographs.

2. The phototopographic map construction can be carried on at the home office while the observer remains in the field, sending in the data as soon as they may be acquired. This renders metrophotography especially well adapted for the use of scientific explorers.

3. The field season is reduced to a minimum, no instrumental observations being required beyond the triangulation which forms the basis for the map. Hence, this method is to be recommended for surveys in mountainous regions, in arid countries or where fogs and smoke prevail, in short, where it is desirable to gather much topographical information in a short time.

Since this method has been developed it has been used successfully by explorers, topographers, military engineers, geologists, hydrographers, etc.

It has been employed with marked success for topographical surveys of large areas in mountain regions in Italy (Mil. Geographical Inst., L. P. Paganini), Austria (Professor Steiner, Pollack, Hafferl, Hübl, Lechner, etc.); Canada (Capt. E. Deville, Surveyor General); France (Col. A. Laussedat; Commandants Javary, Moessard and Le Gros; Dr. Le Bon, Ed. Monet, etc.); and in Germany (Dr. Meydenbaur, Dr. Doergens, Dr. Hauck, Dr. Vogel, Professor Jordan, Dr. Koppe, Dr. Pietsch, etc.). Also for astronomical observations photography has been applied in a similar manner by M. G. Flammarion in France and by Dr. Stolze and C. Runge in Germany.

Phototopography is being practiced now in Greece, Spain, Portugal, Norway, Mexico, Chile, Peru, Brazil, Switzerland, England, and more recently still in the United States, although this art-science has been taught, both in theory and practice, at the Military Academy at West Point by Lieut. H. A. Reed for several years past.

The Coast and Geodetic Survey has, in the past and in the present season, used the phototopographic method in a modified form for the topographical reconnoissance of regions in southeastern Alaska; while phototopography has been used exclusively by the Dominion Land Surveyors for similar work along the boundary between Alaska and British Columbia under Dr. W. F. King, Commissioner to H. M. in 1893 and 1894.

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THE INTERNATIONAL CATALOGUE OF SCIENTIFIC LITERATURE.

The committee appointed by the President and Council of the Royal Society to enquire into and report upon the feasibility of a catalogue of scientific literature through international coöperation presented their report on July 5th. It is as follows (we quote from *Nature*):

At the first meeting of this Committee (February 8, 1894), the Memorial to the President and Council (July, 1893) which led to the appointment of the Committee, and the Minute of Council of December 7, 1893, appointing the Committee, having been read, it was resolved to request the President and Council to authorize the Committee to enter directly into communication with societies, institutions, etc., in this country and abroad, with reference to the